R E P O R T R E S U M E S

ED 019 055 JC 680 129

USE OF COMPUTERS IN JUNIOR COLLEGE INSTRUCTIONAL SYSTEMS.

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PUB DATE 68

EDRS PRICE MF-$0.25 HC-$1.16 27P.

DESCRIPTORS- *JUNIOR COLLEGES, *COMPUTERS, *COMPUTER ASSISTED INSTRUCTION, SYSTEMS APPROACH, SYSTEMS DEVELOPMENT,

MOST OF THE ADVANTAGES GAINED FROM USE OF A COMPUTER ARISE FROM CHANGES IN THE BASIC DESIGN OF THE INSTRUCTIONAL SYSTEM, NOT FROM THE MACHINERY ITSELF. THE SYSTEMS APPROACH TO LEARNING, WHICH IS A CONCOMITANT OF COMPUTER ASSISTED INSTRUCTION, IS CHARACTERIZED BY BEHAVIORALLY DEFINED OBJECTIVES, DIAGNOSIS OF THE LEARNER'S STATUS BY MEANS OF PRETESTS, ACTIVE PARTICIPATION BY THE LEARNER, AND FEEDBACK TO THE LEARNER. A COMPUTER IN THE LEARNING SYSTEM HAS THREE BASIC FUNCTIONS--(1) A SIMULATION MEDIUM FOR STUDENT INSTRUCTION IN DECISION MAKING PROCESSES, (2) A MEDIATING AND CONTROLLING ELEMENT FOR SELF-INSTRUCTIONAL DEVICES OR TEACHING MACHINES, AND (3) AN INFORMATION BANK AIDING IN DIAGNOSIS OF STUDENT LEARNING PROBLEMS AND PRESCRIPTION OF APPROPRIATE TEACHING STRATEGIES. OTHER AREAS OF USE FOR COMPUTER BASED SYSTEMS ARE SCHEDULE MAKING, STUDENT DATA PROCESSING, DATA FILES, LEARNING CENTERS, MANAGEMENT DATA PROCESSING, RESEARCH, AND VOCATIONAL TRAINING. (WO)

USE OF COMPUTERS IN JUNIOR COLLEGE INSTRUCTIONAL SYSTEMS

by

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Seminar: Education 261D

Junior College Curriculum and Instruction

UCLA

Winter Quarter, 1968

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PREFACE

Statement of the Problem. The use of the computer in instructional systems is relatively new. In one form or another computers will make a substantial impact on education during the next decade. It is the writer's intention to review the topic of computers and their use in junior college instruction, and to seek answers to the following questions:

1. What is the status and need for computers in junior college instruction?
2. What is the systems approach and what are its characteristics?
3. How do computers aid in effective learning?
4. What areas can benefit by electronic data processing?
5. What are the requirements for implementing electronic data processing?

Importance of the Problem. There is real promise that computers will assist instructors in helping students develop their creative and communicative abilities; to assist in the diagnosis of students' learning patterns; to select materials appropriate in the learning experience; and to individualize instruction. There is a need by educators to have current information on the use of computers before accepting or rejecting computerized instruction.

Method of preparing the Paper. The method of preparing the Paper will involve a review of current literature in the field of computer technology, junior college curriculum and instruction, research reports, selected papers, occasional reports, technical memoranda, and study reports of cooperative research programs. Additional information will be obtained through visitations to junior college campuses and interviews with persons involved with computers and instructional programing.

CHAPTER I

NEED FOR COMPUTERS IN JUNIOR COLLEGES

The effects of the use of computers as a result of the information explosion reach virtually every citizen in this country; and the applications include everything from recording our births, keeping statistics on our education, assessing our taxes, checking changes in our financial status, recording our achievements, determining our medical needs, to predicting what will be our span of life.

The use of computers has expanded at an amazing rate. In 1964, there were almost 25,000 computers installed and some 10,000 on order in the United States. By 1970, a predicted 52,000 systems will be in use -- representing close to a $12 billion investment.

Dr. Peter Masiko, Jr., President of Miami-Dade Junior College, has given priority to the computer for the future.

> The time has long passed when college administrators have had to decide if they are to automate their data system. The question to be answered is "how soon and to what extent can the management aspect of college administration be helped by the use of electronic data processing?" The need for information processing of the data available is so great that conventional methods cannot produce satisfactory results even with unlimited manpower resources. (21:45)

INFORMATION EXPLOSION

Society is experiencing perhaps the most profound change in its history. At the heart of this change is the information explosion. In 1800, it was estimated the sum of human knowledge was doubling every fifty years; by 1950, the sum of human knowledge was doubling

every ten years; and predictions are that knowledge will continue to expand; and by 1970, will be doubling every five years.

Education both contributes to and is affected by this information explosion. Because of the rapid rate of technological change that now exists, it is generally expected that today's student must expect to train (and retrain) for at least three different careers during a lifetime. Even in those professions where titles may not change, periodic updating of an intensive nature is already a necessity.

Traditional approaches and procedures regarding when, how, and what is taught must be continually assessed; therefore, the roles, responsibilities, and concepts of the library, text materials, and instructors must, of necessity, change. Although the precise nature of these changes cannot be predicted it is clear that computers will play an increasingly major role. A major contribution to improved instruction can come from computer sciences. The demands of today make it abundantly clear that radical changes in the concepts and operation of education must come, and come soon.

STATUS OF COMPUTERS

The work done thus far in computer-mediated instruction can best be described as a prologue to what must come.

> Computer-based instruction is an area of great potential, but one in which relatively little has been done thus far. There has been much speculation, some conceptualization, a few research studies, and even less implementation, even on an experimental basis.
>
> Generally speaking, good efforts in research and development have been lacking. Research efforts in this area appear to fall into two groups: those concerned mainly with hardware

> and those of programmed-learning enthusiasts. Equipment-oriented researchers frequently seem to have the means confused with the end. The computer is merely a means to the goal of better learning and teaching. (19:81-2)

In comparison with rapidly expanding applications in business, science, and government, computer technology in education has lagged far behind. Surveys indicate that approximately 300 of the 2,100 colleges and universities, and about the same number of the 33,000 public school districts in the United States now own, rent, or use electronic accounting machines (EAM) or computers.

At the present time, although interest among educators and applications in schools are increasing rapidly, the computer sciences have had only limited impact on education. Automated school information systems are being developed at an ever-increasing rate, but they must be regarded as the exception rather than the rule. Some attention is being given to other computer applications: those involving instruction, research, school administration, guidance, and related elements of the educational program. However, these are so limited in number that they must be considered as innovative and experimental. Significant improvements in educational productivity will result as computer technology continues to grow and expand in scope.

Simple electro-mechanical machines have definite limitations. It is the high-speed electronic computer, center of advanced information system technology, which is receiving the most attention from educators. Large-scale, programmed computers, with their vast resources of speed, storage capacity, accuracy, and versatility, are now demonstrating their utility in almost every information aspect

The computer is finding application in general business accounting - the financial and property accounting of all school business; student accounting - the processing and record-keeping necessary to guide, regulate, and record student activities; general administration - the over-all regulation, direction, and control of students and employees based upon the policies and practices specified by local district, state, and national educational systems; and school instruction - the presentation to students of programmed curriculum materials, and the rapid retrieval of documants and reports for instructional purposes.

CHAPTER II

SELECTED COMPUTER-ASSISTED INSTRUCTIONAL SYSTEMS

We must accept the premise that learning is the reason for instruction, and generally speaking, if a student fails to learn the instruction has failed or the instructional program is inappropriate. It is incumbent upon the two-year college to accept the challenge to teach successfully and to seek out all possible ways and means to ensure that students do learn.

In a Paper presented to Cuyahoga Community College faculty on the use of the developing educational technology J. Philp Dalby states that we can improve our courses and methods of teaching.

> The teacher will become more efficient. Repetitious processes will be eliminated. More time will be made available for individual tutoring and student consultation, preparation, and follow-through. The teacher will have time and energy to help students with those problems that only a live, thoughtful and responsive person can assist in resolving.
>
> Students can progress at individual rates. More flexible scheduling will be practiced. Students must develop more inidividual initiative, but will be given more individual attention. Because of individual differences among students, the multiple media will contain means of communication that should be conducive to developing motivation, interests, and success among a larger proportion of students.
>
> Tests will be more easily graded and evaluation will be more accurate. Results will be quickly available. There will be more use of common, validated tests in multiple-section courses.
>
> The more common subjects and courses will be standardized within an institution. Material will be presented in a variety of ways which are designed to intensify learning. More emphasis will be placed on perception in the learning process, based upon the theory that perception and conception develop in reciprocal relationship. (30)

The efficient teacher must have a method - system for determining what teaching resources are available and for constantly deciding how best to use them with individuals and groups of pupils of various sizes. Instruction will become increasingly dynamic and complex, and more of the teacher's attention will be needed to monitor and control the instructional process so that students will be engaged in maximally effective learning at all times. Students having experienced truly individualized and enriched instruction and immediate feedback of the results of their work, will demand rich and meaningful instruction.

Systems Approach. Most of the advantages gained from the application of an automatic computer come not from the use of the automatic computer itself, but from changes in the basic design of the systems to be used. An instructional system has been defined as a collection of components which are designed to achieve a specific set of instructional objectives. What has been done historically for the individual learner and what is being done as a result of the application of of the systems approach are related but significantly different. The latter is an outgrowth of the former but is characterized by the systematic application of what we have learned over the years about testing, learning and instruction; it is the orchestration of diagnosis, prescription, instruction, counseling and evaluation. In order to accomplish this orchestration in relation to individual needs and differences, an integrated and efficient technic of combining management skills, information processing methods, and instructional strategies and resources is required. This is best accomplished through the systems approach

and usually involves the use of computers, though it can be managed without them.

Characteristics in the modern instructional system.

The following are the characteristics which are likely to be present in the modern instructional system.

1. Instructional objectives will be defined in behavioral terms. They will specify what the learner must be able to do, the circumstances under which he will do this, and the degree of competence with which he will perform after working through the system. The specification of behavioral objectives does not, by itself, constitute a system. However, such objectives must be present in a system. While this is not a new idea, it has had only limited application in traditional instruction.
2. The system will provide the kind of diagnosis which will indicate whether or not the learner already has sufficient mastery of the instructional objectives and, if he does not, whether or not he has the prerequisite behaviors to achieve success with the subsystem. In addition to diagnosing the learner in relation to the specific topic at hand, the system will draw on a data bank for each individual, which will enable it to accommodate individual differences to a far greater degree than is possible through conventional instruction. Individual differences refer to ability, aptitude, experience, interest, learning rate, and learning (cognitive) style.

There are wide differences among individuals in the way they learn different subjects. Different modes of instruction are effective in facilitating certain kinds of learning among different individuals. By different modes of instruction is meant different media and strategies of instruction or both.

Diagnosing learning style is not yet a well-developed technic. A theoretical framework for such diagnosis is not yet well developed. Computers have been and will continue to be invaluable in generating the kind of empirical data which will enable us to build effective diagnostic instruments.

3. The system will require active participation by the learner. This means that in moving through the system, the learner will do something other than absorb information or instruction. He will be reacting, in a variety of ways, to stimuli provided by the system.

4. The learner will be provided with effective feedback on the appropriatness of his responses to stimuli from the system. The nature of this feedback will vary according to the characteristics of the learner and the characteristics of the instructional problem.

The systems approach puts a premium on planning, and it puts emphasis on the coordination of all related parts. It also calls for the elimination of unnecessary components, a formidable task when jobs and long-standing practices are involved. That, in turn, calls for sound leadership and personnel administration. The best systems analysis and design will only be as good as its execution.

CHAPTER III

THE COMPUTER IN THE CLASSROOM

The computer as an aid to effective learning has three basic functions. It serves as:

1. a simulation vehicle for student instruction in decision-making processes.
2. a mediating and controlling element for self-instructional devices or teaching machines, and
3. an information bank aiding in the diagnosis of student learning problems and the prescription of appropriate teaching strategies.

A Simulation Vehicle for Student Instruction in Decision-Making Processes

Simulation has been a part of instructional methods at all levels of education for many years. With the use of the computer, classroom simulation can increase in realism and complexity. For example, at El Camino Junior College simulation techniques are utilized in business education, economics, maths, and physics. At the St. Louis Junior College District simulation techniques are being used to forecast building and staff requirements under varying academic conditions. The research staff of the Board of Cooperative Educational Services in Yorktown Heights, New York, has simulated chemical analysis in an experimental program. Seated at a typewriter keyboard linked to a computer, the student directs the computer in a step-by-step chemical analysis. From a desk viewer the student observes the results of each instruction to the computer. If the student orders a mixture of certain chemicals, a colored slide projected onto the viewer shows the reaction of the mixture.

A Mediating and Controlling Element for Self-Instructional Devices or Teaching Machines

Certain principles of learning, developed in psychological laboratories and validated in educational practice, have currently been applied with considerable success to the development of new self-instructional textbooks and teaching machines. These principles have been identified with the educational process called "programmed learning."

The potential of the computer for handling individual student differences in learning rate, background, and aptitude is of primary interest to researchers working with computer-controlled automated teaching machines. Responsiveness to student learning behavior can be achieved by branching the student forward, laterally, or backward through subject materials primarily on the basis of his response to content questions seeded throughout the instructional program.

The only type of control unit which provides the necessary flexibility for branching is the digital computer, because the computer is the only instrument capable of determining the item sequence and knowledge of results to be presented to the student as well as carrying out the bookkeeping activities upon which such determinations are based.

Future plans include the establishment of typewriter stations remote from the central computer system. This would permit students located in a wide geographic area to be linked into one network via leased telephone lines, which are called teleprocessing. An experimental program financed by federal funds is currently connecting

students in the Appalachian region via telephone lines with Stanford University's computer 2,000 miles away. The program is routed through the Morehead State University and includes first through eighth graders, Upward Bound and Neighborhood Youth Corps students, teachers aide trainees, and adult basic education enrollees.

An Information Bank Aiding in the Diagnosis of Student Learning Problems and the Prescription of Appropriate Teaching Strategies

A facility for the research and development of a complete educational system that would provide optimal learning conditions has been in use at the System Development Corporation for research. This facility, designated CLASS (for Computer-based Laboratory for Automated School Systems), is a part of the large, general purpose Systems Simulation Research Laboratory.

CLASS permits simultaneous automated instruction of twenty students, each of whom receives an individualized sequence of instructional materials adapted to his particular needs, or learns in a group mode of instruction mediated by the teacher or computer. The computer maintains performance records for all students and makes these records available to the teacher, or counselor, or administrator. CLASS also permits instruction, in either the individual or group mode, through different media including television, films, and slides as well as conventional lecture and textbook methods. With such a system the impact of automation on the roles of guidance, instructional, and administrative personnel can be carried out.

Liberated from most record-keeping, paper-grading, and the

basic necessity of packing students full of factual material, the teacher can concentrate on the extension of student understanding, on stimulating student creativity, on challenging student imagination, and on providing individual help and counsel.

Another computer research facility in the area of automated teaching is PLATO, a project being developed in the Coordinated Science Laboratory of the University of Illinois. The main objective of PLATO is to provide a system capable of tutoring a large number of students concurrently in a variety of subject materials.

At the 1966 Convention of the American Association of Junior Colleges the PLATO system and similar computer assisted teaching techniques were described as being in the experimental or initial testing stages. The future of this type of teaching system looks very hopeful. The PLATO teaching system utilizes, in addition to a medium-size computer, the following pieces of equipment:

1. Student stations consist of an electronic key set (similar to a typewriter keyboard) as a means of communicating with the central computer and a television screen for viewing information selected by the computer.

2. The electronic book is composed of a bank of slides prestored in a slide selector which is controlled by the computer. Information stored on the slides is the type normally found in a textbook or class notes.

3. The electronic blackboard consists of a computer controlled storage tube for each student station. Diagrams, symbols, and words are plotted in a point-by-point fashion on the student's storage tube.

The actual teaching process is governed by a set of rules called the "teaching logic". The experiments to date have explored two types of approaches: the "tutorial" logic and the "inquiry" logic.

In the "tutorial" logic system a student is presented with facts and examples and then is permitted to ask questions about the material presented. The student then can compose answers, and when he is ready, ask the system for a judgment.

In the "inquiry" logic a student can request information from the system, or it permits what is sometimes called a dialog between student and computer. The student directs his learning by composing his own requests.

One of the important "by products" of the use of the PLATO system is the record of the student's performance that can be accumulated by the computer. This record is of great value to the teacher for instant analysis of student performance and review of validity and difficulty level of material presented, allowing for alteration of the program as modifications become necessary on a current basis.

The University of Illinois is currently using the PLATO system in a "live" classroom environment in the following for credit courses: circuit analysis in the electrical engineering programs, Fortran programming for business and commerce students, and "How to Use the Library," with additional courses being developed.

CHAPTER IV

DATA PROCESSING APPLICATIONS

The complexity and the changing state of computer science and art requires skilled and knowledgeable technical planning for implementation. Computer based systems can provide greatly augmented and new capability in the following areas.

1. Computer Assisted Scheduling

With methodological and procedural techniques now developing, the computer can be an indispensable tool for the scheduling of complex interactions. A computer subsystem can schedule curriculum, instructor assignment, facility assignment, student work load, courses of variable length, and all other interactive elements to support and facilitate individualized and flexible learning. At Bakersfield Junior College the computer is used in conjunction with the counseling department to schedule students electronically, while still offering them choices of classes, times, and instructors. The student has a better than 92% chance of obtaining his first choices of courses, times, and instructors; whereas he had only about a 70% chance of all three under the more traditional manual system.

2. Student Data Processing

This computer use offers the teacher, counselor, or school administrator immediate access to a wide range of relevant information

about any single student. Such information can facilitate early and appropriate responses to behavior problems, educational difficulties, attitudinal or motivational issues, or related administrative problems. In the next five years student data banks can be made more specifically responsive to the needs of the school personnel who use them; ultimately, they will become finely sensitive tools available to support the kinds of relationships that are necessary if each student is to be treated as an individual human being.

3. System Data Files

An educational system can be viewed as a large, complex information-processing system. It requires more and more records on ever larger numbers of students, teachers, and administrators. Complete records of learning, health, and administrative actions are vital, of course, but efficiency requires that they be progressivley automated, both in their generation and in their storage and retrieval. Computer systems increase the efficiency with which this necessary information can be developed, stored, and retrieved. They make it possible to analyze and collate these data automatically or on demand, Even more important, they enable teachers and administrators to make more useful and meaningful predictions based on the data.

4. Computer Centered Learning

The new computerized learning center offers the first real opportunity for individualizing the educational experience for millions

of students. In almost infinite variety and form, the computer as a teaching tool can stimulate and motivate a new degree of excitement in learning. It can allow students to engage in individual learning games; it can respond directly and immediately to the student's own temperament and learning style. It can be the equivalent of a "master instructor" who is totally responsive to the learning needs of the particular student. As a direct teaching and learning tool, the computer offers the likelihood,over the next decade or two, of making learning an exciting and welcome experience for every student.

5. Management Data Processing

The well-defined tools and techniques of management control information systems that have been developed in many other aspects of the American economy and in military areas are now available to the junior colleges. They afford the capability for immediate access to information and analysis on personnel administration, purchasing and procurement, administrative control, financial planning, and other management subsystems.

6. Educational Research

Research has been severely constrained in education because the data necessary for significant findings have been fragmented and difficult to obtain. Computer centered learning and the availability of data on all the other computerized subsystems offer the opportunity to do really significant research on human learning. Computer centered educational support systems may provide a capability for answering fundamental questions about how students learn.

An analysis of test results is available for the instructors at Bakersfield College as the result of a computer innovation designed to aid the faculty and ultimately to improve instruction through improving faculty skills in measuring achievement. A teacher constructed test program offers the faculty an opportunity for the machine scoring of objective-type tests. An item analysis is a strong feature of the program as it discriminates between good and poor students, and it provides a measure of difficulty for each item. It also indicates the usefulness of the various incorrect alternatives im multiple choice items. Item analysis, standard scores and other electronically provided data save literally thousands of instructor hours and provide information that many instructors previously had neither time nor skills to calculate.

7. Vocational Education

This field in particular will be profoundly influenced by computer technology. The computer offers a new capability for planning vocational education so that training in the schools is closely matched with job requirements and job opportunities in the community. It offers the possibility of computer-centered vocational education, that is, training for vocational skills in a high-motivation, accelerated-learning environment. Already, computer controlled simulation of a job environment is being integrated with a computer tutorial teaching system so that students can learn a vocation in both theoretical and on-the-job contexts. Varied forms of simulation and learning games can enormously facilitate and expedite vocational education.

REQUIREMENTS FOR ELECTRONIC DATA PROCESSING

There is a need for the following requirements if effective and economical electronic data processing is to be implemented.

1. A centralized system design covering the full range of requirements and services sought.
2. A development plan extending over a number of years for purchasing and integrating the elements of the total centralized system. Such a plan may include subsystem options which can be purchased in the quantity and at the rate deemed most desirable.
3. A knowledgeable, experienced system manager who can monitor and direct the implementation of the system.
4. Develop a complete program for training school district personnel in electronic data processing and in the use of each of the computer subsystems.
5. Strong leadership and support is required on the part of the responsible officials of the school district. In order to achieve the efficiencies and economies of a centralized computer system, it is necessary for the officials of the educational system to decide as early as possible what they want and where they are going with regard to electronic data processing.

SUMMARY AND CONCLUSIONS

The purpose of the study was to examine the use of computers in Junior College instruction and to answer questions on their status and need. The systems approach and characteristics in the modern instructional system were reviewed. Several experimental computer assisted teaching techniques were explored, as were areas of application. Outlined were the requirements for implementing effective electronic data processing.

Computer-based instruction is an area of great potential, but one in which relatively little has been done thus far in Junior Colleges. Several large Junior Colleges are giving priority to the installation of advanced computers. The need for information processing of data is so great that conventional methods cannot produce satisfactory results. The demands of today make it abundantly clear that radical changes in the concepts and operation of education must come very soon.

The computer is finding application in general business, student accounting, general administration, and instruction. Most of the advantages gained from the application of an automatic computer come not from the use of the automatic computer itself, but from changes in the basic design of the systems to be used. An instructional system has been defined as a collection of components which are designed to achieve a specific set of instructional objectives. The systems approach is characterized by the systematic application of what we have learned over the years about testing, learning and

instruction; it is the orchestration of diagnosis, prescription, instruction, counseling and evaluation. In order to accomplish this orchestration in relation to individual needs and differences, an integrated and efficient technic of combining management skills, information processing methods, and instructional strategies and resources is required. This is best accomplished through the systems approach and usually involves the use of computers. The systems approach puts a premium on planning, and it puts emphasis on the coordination of all related parts.

The potential of the computer for handling individual student differences in learning rate, background, and aptitude is of primary interest to researchers working with computer-controlled automated teaching machines. Computer assisted teaching techniques in initial testing stages for optimal learning conditions are provided in several facilities, including CLASS and PLATO.

Computer based systems can provide greatly augmented and new capability in the following areas. 1. Computer Assisted Scheduling, 2. Student Data Processing, 3. System Data Files, 4. Computer Centered Learning, 5. Management Data Processing, 6. Educational Research, and 7. Vocational Education.

To implement an effective and economical electronic data processing program requires a cenralized system design covering the full range of requirements and services sought. A development plan extending over a number of years under the direction of an experienced system manager is needed. There should be developed a complete program for training district personnel in electronic data processing.

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